Safe airway management and ventilation is one of the central tenets of anaesthesia. Fortunately, the failure of equipment for gas delivery is a rare event. An analysis of the database of the American Society of Anesthesiologists Closed Claims Project between 1962 and 1991 found that gas delivery equipment was associated with only 2% (72) of these claims, but the consequences tended to be grave: three-quarters involved death or permanent brain damage. In a recent simulation-based study, the only error made by all participants related to the management of a failure in oxygen supply. It is clear that anaesthetists should be trained to recognize and deal with problems of this type, and reinforce those skills regularly throughout their careers. But what is the best way of doing this?

Recently, an experienced and highly regarded consultant anaesthetist faced disciplinary action for carrying out a training exercise in which he told a trainee with whom he was working that he was leaving the operating theatre for a coffee break, switched off the mains electricity supply to the anaesthetic machine without checking that the backup battery was functioning and left the trainee to deal with the consequences. Neither the trainee nor the patient had been informed that he intended to conduct such a training procedure. The ‘Fitness to Practice Panel’ of the General Medical Council found that in doing this he had exposed the patient to a risk of harm (although no harm resulted as the trainee successfully initiated alternative means of ventilation). The panel concluded that the consultant’s actions were out of character and misguided, but did not constitute misconduct. In view of his exemplary character, it was determined that his fitness to practice was not impaired, and no further action was taken. The case was widely reported in the media, and many anaesthetists commented at the time that they too had been tested in similar ways during their training.

Expectations within society change over the course of a career. When one of us began practising anaesthesia in the early 1980s, this story would have been unremarkable. That is no longer the case, and it is easy to imagine how it would be regarded by the general public today. Many patients may accept the value of such training, but the keys are consent and transparency. The trainer should explain to the patient beforehand that he or she would like to conduct some safety drills during the case to ensure that the operating theatre team can manage real emergencies effectively. It should be made clear that these drills will be supervised and are unlikely to lead to harm, and that declining consent would not affect the patient’s treatment. It would be prudent for consent to be recorded in the notes. Many patients may decline, but this is their right. More pragmatically, it is also a price worth paying when the alternative may lead to disciplinary action and adverse publicity. Furthermore, there is, today, another way of achieving the same educational objectives.

It is no longer necessary to expose people to risk to teach physicians how to manage scenarios that are rare but may have serious consequences for patients. Such incidents can easily be reproduced in a high-fidelity patient simulator without involving patients at all. Modern simulators driven by sophisticated physiological and pharmacological models allow properly structured exercises with defined educational objectives and assessment criteria to be undertaken with very high levels of realism. Participants typically engage strongly in the simulated scenarios and find the experience convincing and of value. Training may focus on the routine (teaching a foundation year trainee how to deal with a patient with arrhythmia) or the exotic (such as managing malignant hyperpyrexia). Technical and non-technical skills can be honed. Opportunities for facilitated reflection can be provided immediately afterwards, without the need to attend to the next clinical priority. Anaesthesia Resource Crisis Management (ACRM) courses are now well established in many centres. For example, in the Effective Management of Anaesthesia Crisis (EMAC) courses run under licence
from the Australian and New Zealand College of Anaesthetists, anaesthetists practice cognitive and technical skills (reading chest radiographs and intubating the trachea in the presence of a suspected injury of the cervical spine) and receive instruction in non-technical skills such as dynamic decision-making, human performance issues in the perioperative setting, and in the principles of crisis resource management adapted from those taught to pilots. Didactic lectures are followed by drills, and the lessons from these are then reinforced by participation in videotaped simulation-based clinical scenarios followed by debriefing with an emphasis on reflective learning.

This course shows the importance of teaching technical and non-technical skills; only with competence in both will anaesthetists provide the best possible care. ANTS (Anaesthetists’ Non-Technical Skills) is a system for organizing desired skills into a hierarchy to structure training and assess performance. These skills are classified as task management, team working, situation awareness, and decision-making. Since human error is implicated in 80% of adverse anaesthetic events, these human factors are of prime importance but poorly taught. High-fidelity simulation provides an opportunity to emphasize the importance of and teach these skills. Again, we are following where the aviation industry has already flown.

High-fidelity simulation is being increasingly used in the teaching of medical students and trainees and for research, yet it still has a relatively narrow evidence base. No studies have been published to show that simulation in medicine improves doctors’ performance and reduces real patients’ morbidity and mortality. However, there is some evidence that performance, in isolation, is improved. Surgeons undergoing laparoscopic training showed increased speed, accuracy, and reduced number of movements. Simulation-based training in medical emergencies resulted in improved management of ‘new’ challenges, evidence perhaps for an increase in transferable skills. The Chief Medical Officer (CMO) sees this as sufficient basis for recommending a fuller integration of simulation into the health service. High-fidelity simulation centres are expensive to establish and run. The CMO recognizes the costs involved and that at present these are borne predominantly by trainees, but at a time of shrinking training budgets, there may not be the political appetite to fully fund an integrated simulation training programme.

In the airline industry, in contrast, simulation is accepted as part of every pilot’s training and continuing professional development. Once qualified, pilots typically undertake simulation-based training and assessment twice a year. Failure to achieve the expected standard leads to immediate withdrawal of flying privileges, but this is accompanied by intensive and timely additional training with the aim of ensuring that a repeat evaluation is passed successfully. The result is that the public can be reasonably assured that pilots do indeed have the required core competencies to carry out their duties safely. In anaesthesia, we should aim for nothing less. Not for the first time, anaesthetists are leading the medical profession in the promotion of safer and better ways of working. Imagine hearing an announcement from a pilot to the effect that on this trip the aeroplane will be flown by a neophyte trainee, who will be conducting certain drills (including closing down an engine) in the interests of his or her educational needs, but that there is no need to worry because supervision will be provided. The day when the public consider this method of training equally unacceptable in anaesthesia may not be far away.

We are well down the track of establishing a viable alternative. We can see that individual doctor’s performance is improved after simulation training, but what real effect does this have? The holy grail of simulation in medicine is often said to be validating its effect upon patient safety and patient outcome, so as to justify full funding of simulation-based physician training. Anaesthesia has taken simulation further than any other speciality but is still far short of what is possible. We should not stop now.

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References
9 Degnan BA, Murray LJ, Dunling CP, et al. The effect of additional teaching on medical students’ drug administration skills in a simulated emergency scenario. Anaesthesia 2006; 61: 1155–60
An appropriate intravascular volume replacement is a fundamental component of managing the critically ill surgical or intensive care unit (ICU) patient because the failure to treat hypovolaemia may progress to organ dysfunction or even death. Although the importance of adequate volume replacement is widely accepted, there are still no unique accepted recommendations. Aside from different crystalloid solutions, the natural colloid human albumin (HA) and different non-protein (synthetic) colloids have been promoted to treat volume deficits. Over the recent years, some misconceptions or myths of volume replacement concepts have been established that need to be reconsidered and to be corrected when necessary.

First misconception: saline is a physiological solution

Saline solution is an isotonic crystalloid that is still the dominating crystalloid worldwide. It has been termed ‘physiological’ or ‘normal’ saline, but when it is compared with the composition of plasma, one must wonder why it has ever been termed as ‘physiological’. With its high sodium (154 mmol litre⁻¹) and high chloride (154 mmol litre⁻¹) concentrations, it is far from being a plasma-adapted solution. In the early 1990s, substantial alterations in acid–base status were described in patients in whom considerable amounts of saline solution were infused—this was defined as ‘hyperchloraemic acidosis’. As a low base excess (BE) may serve as a surrogate marker to identify patients with underperfused tissues, producing (hyperchloraemic) acidosis by administering fluids of an unphysiological composition, we may mask the diagnosis of perfusion deficit or make inappropriate clinical interventions due to the erroneous presumption of ongoing tissue hypoxia secondary to hypovolaemia. In a study in ICU patients, the BE was shown to predict outcome. BE may also be used to identify patients who have a high risk of mortality and thus should be admitted to the ICU. In patients undergoing cardiac surgery with cardiopulmonary bypass, BE measured during the first hour after surgery was correlated with the length of ICU stay.

Aside from experimental studies showing negative effects of hyperchloraemic acidosis, there is increasing evidence for negative effects in humans. In healthy volunteers in whom 50 ml kg⁻¹ of either normal saline (NS) or Ringer’s lactate (RL) was infused, metabolic acidosis developed in the NS group and time to first passing urine was increased significantly. In a study of patients undergoing elective lower abdominal gynaecologic surgery who received ~6 litre of either NS or RL, the NS-treated patients had a lower urine output. In patients undergoing abdominal aortic aneurysm repair given either RL (total dose: 6.8 litre) or NS (total dose: 7 litre) in a double-blinded fashion, only the NS-treated patients developed hyperchloraemic acidosis and they needed significantly more blood products. In patients undergoing kidney transplantation, either ~6 litre of NS or RL was given. NS

Seven misconceptions regarding volume therapy strategies—and their correction

Anesthesiology 2007; 107: 705–13


13 Webster CS, Merry AF, Gander PH, Mann NK. A prospective, randomised clinical evaluation of a new safety-orientated injectable drug administration system in comparison with conventional methods. Anesthesia 2004; 59: 80–7


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Editorial II

Seven misconceptions regarding volume therapy strategies—and their correction